

**IDA**

**INSTITUTE FOR DEFENSE ANALYSES**

**Synthetic Environments for  
National Security Estimates (SENSE)  
Report of the Peer Review Group**

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## PREFACE

Synthetic Environments for National Security Estimates (SENSE) is an interactive, computer-based game developed by the Institute for Defense Analyses. IDA's President, General Larry Welch, commissioned an independent peer review of SENSE development activities in March, 1998, with the dual purpose of providing an assessment of the utility of SENSE in its initial planned application in Bosnia, and providing a technical assessment of the game.

The panel brought a wide range of perspectives to the review. Professor Clopper Almon is an internationally recognized authority on macroeconomic modeling, and is the Director of the University of Maryland's INFORUM center. Mr. Dayton Maxwell served in Bosnia with the Agency for International Development, and has maintained an extensive involvement in Bosnia through his current position with World Vision International. Professor Peter Murrell advises governments making the transition from socialist to market economies, and has systematically studied the alternative strategies that nations have adopted to manage this transition. Professor Gregory Saathoff is a psychiatrist who advises the US government on many aspects of conflict resolution. Dr. David Graham is an economist, and currently the Assistant Director of IDA's Strategy, Forces and Resources Division.

The panel performed its review during July and August, 1998. The peer review group met first on July 20<sup>th</sup> to be briefed on the SENSE development activities and to participate in a developmental test gaming session. Three of the four panelists (Messrs. Almon, Murrell, and Maxwell) also participated in some or all of the SENSE roll-out on July 30<sup>th</sup> and 31<sup>st</sup>. The fourth panelist (Dr. Saathoff) was represented by two of his colleagues at the roll-out. The peer review group reconvened on August 3<sup>rd</sup> to provide their assessment of the utility of SENSE, their recommended future directions for the development activity, and their near-term priorities for SENSE development.

This document summarizes the findings and recommendations of the panel.

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## EXECUTIVE SUMMARY

During the summer of 1998, a group of independent experts was convened at the request of the President of the Institute for Defense Analyses to review IDA's work in developing the computer-based simulation game known as Synthetic Environments for National Security Estimates (SENSE). These experts were selected because of their recognized credentials in the fields of macroeconomics, the economics of transition economies, psychology and conflict resolution, and on-the-ground international aid activities. The panel observed and played SENSE games, and reviewed its technical underpinnings.

The panel finds that SENSE has significant potential value. They see in SENSE a creative endeavor, and support its application to the challenges of economic development, and post-conflict recovery. One reviewer experienced in dealing with policy makers in transition economies cites the potential for using such games as a means to get practitioners to understand the behavior of market economies. It affords a learning-by-doing environment that players find highly engaging. It can be compared to a flight simulator, in that it allows policy makers, banks, and firms to "test-fly" alternative strategies in a developing economy. They can make a lot of mistakes – and learn from them – without actually incurring the attendant damage.

The panel offers a wide range of ideas for strengthening the SENSE framework and for expanding its scope and applications; many of these are long-term development activities in the areas of economic behavior of the model, business play, the role of government, and the psychological dimensions of play. The panelists also identify a number of high priority tasks that should be completed prior to the model's initial application later in 1998.

Panelists concur that the SENSE framework can be made ready for fielding within about three months of a commitment to do so, provided adequate resources are available. This will require limited software modifications, a focused effort to establish the accompanying seminar structure and player tutorials, translation of the model to the host nation's language and training of translators, and field-testing to fine-tune the relationship between the seminars and the game.

## **I. INTRODUCTION**

IDA initiated the development of Synthetic Environments for National Security Estimates (SENSE) in order to create an interactive game that would allow participants to examine issues where economic and security concerns overlap. Infrastructure protection against economic terrorism, the targeting and application of economic sanctions, and the interplay of economic development and political stabilization represent the kinds of areas where a better understanding of economic behavior could contribute to the formulation of security strategy. The first planned application of SENSE in Bosnia focuses on the last of these areas – how economic recovery and development depend on, and contribute to, political, military, and social stability. This section summarizes how SENSE is being used in this application in order to set the context for the review panel's findings and recommendations presented in the subsequent sections.

### **A. OVERVIEW**

The first application of SENSE provides a scenario in which the growth and development of a developing economy, "AKRONA," is shaped by the interactive decisions of the participants. They play the roles of firms, financial institutions, international organizations, and the government. In its current configuration, the AKRONA economy includes six domestic firms, a transnational firm, one domestic financial institution, an international aid organization, a foreign government, and the domestic government. Typically, twenty to forty players participate in each gaming session. Player interactions are managed through a distributed computing network, which also supports the underlying analytical structure of the game. The roles to be played and underlying economic conditions can be tailored to meet a wide range of game-playing requirements.

The AKRONA economy comprises 24 product and service categories (listed in the accompanying table). The players make investment, production, pricing, and budget allocation decisions affecting each of these sectors in each simulation period. The firms can be thought of as conglomerates, because they are free to make investments across a range of these product and service categories. The financial institutions provide loans to the firms to finance their investments. International organizations may invest directly in the product or service categories, or they may make loans to the domestic firms. The government sets tax rates and allocates revenues to defense, education, and social welfare programs.

#### SENSE Product and Service Categories

Agriculture Raw materials Coal Petroleum Chemicals Electricity Railroad services Heavy industry	Light industry Food Clothing Household goods Industrial construction Residential construction Motor vehicles Aerospace manufacturing	Ships and boats Trucking services Water transportation Air transportation Communications & business services Tourism & entertainment Telecommunications Defense & public services
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The goal of the SENSE game is to provide a learning-by-doing environment. Through game play, players will gain insights regarding the behavior of market economies, and will be able to examine how alternative economic strategies influence players' behavior and hence economic development.

The SENSE analytical framework employs an input-output structure to capture the inter-industry demands that flow down from final-goods industries to indirect suppliers. For example, production of motor vehicles will create indirect demands for raw materials, coal, electricity, railroad services, and so forth.

In addition to those aspects of the economy driven by participants' decisions, there are several others that are represented with standard economic modeling relationships. The modeled variables relate to employment, wages, imports, exports, inter-industry demands, and household consumption. Modeled aspects of the economy

are calibrated to provide a representative context for each simulation game. Participants' decisions interact with these modeled variables to determine each period's outcome. In each simulation period, participants are provided feedback on the consequences of their decisions. Reported statistics include market clearing prices, sales, profits, production capacity, and accumulated inventories, along with macro-economic and social indicators.

Usually, a simulation period is one month, which is played in real time of a few minutes. A typical SENSE simulation session runs for a few hours, and may cover a game period of 60 to 72 months.

The SENSE simulation game is to be played in the context of a seminar program. The program, which is still under development, has four main components. It will explain the broad principles of economic development, highlight the kinds of policies and issues that are captured in the SENSE simulation game, familiarize participants with the play of the game, and provide after-action reviews of game outcomes and lessons learned. Game playing will reinforce the ideas addressed in the seminars, and even more importantly, show how these ideas can be implemented through the kinds of everyday decisions made by firms, financial institutions, and governments. This combined approach is expected to be far more powerful than an approach relying only on seminars, because the game is highly engaging to participants, and it introduces an element of learning-by-doing to the seminar approach.

## **B. IDA'S DEVELOPMENT ACTIVITIES**

This peer review is one element of a multi-year development effort undertaken by the Institute for Defense Analyses. IDA began its work on synthetic environments in 1996 in collaboration with Purdue University's Krannert School of Management. That work focused on demonstrating the concept and feasibility of interactive economic simulation games.

In 1997, IDA merged its synthetic environment development activities with an ongoing program of activities supporting the Marshall Center. By that time, IDA had long been supporting the Center in its mission to teach US methods for national security planning and defense management to officials from Eastern Europe and Former Soviet Union nations. Through this work, IDA developed seminar-based teaching methods that

had proved to be highly effective for these target audiences. It was anticipated that a merger of the seminar and SENSE gaming approaches would offer these officials an effective way to understand and address the economic policy issues they are facing.

After being briefed on the IDA seminar-gaming approach in the Fall of 1997, the Commander in Chief of US Forces in Europe decided that the IDA seminar-gaming approach should be employed in Bosnia. He concluded that SENSE provided a new approach for persuading Bosnian leaders that the future of their country depended on creating conditions conducive to economic recovery and development. Throughout 1998, IDA has focused its SENSE development efforts on completing the development of the SENSE framework needed for use in Bosnia; this has resulted in the framework described in the preceding paragraphs. IDA tested this framework extensively in June and July, and at the end of July, IDA sponsored a "roll-out" of SENSE. A wide range of senior officials attended a preliminary version of the seminar materials, played two sessions of the SENSE game, and participated in after-action reviews. As described in the Preface, this peer review has been conducted in parallel with these testing and roll out activities.

### **C. ORGANIZATION**

This document summarizes the deliberations of the SENSE review panel. Chapter II presents the panelists' views on the utility of the SENSE game. Chapter III provides their technical assessment of the SENSE framework. Comments focus on the economic behavior of the game, the business aspects of play, government options and behavior, and the psychological dimensions of the game. Chapter IV describes the additional preparations necessary to prepare SENSE for fielding. Finally, Chapter V highlights the high-priority next steps proposed by each of the panelists.

## II. THE VALUE OF SENSE

The review panel believes that the SENSE game has clear potential value in a wide range of applications. SENSE is a creative, exciting endeavor, which the panelists see as unique in its application of interactive computer gaming to the challenges of economic development. One reviewer with experience in dealing with policy makers in transition economies sees exciting possibilities for using such games as a means to get practitioners to understand how an economy works. Another reviewer emphasized that host nation participants could build on these initial applications, and use of the framework to frame alternative economic strategies to be examined by influential members of the government, academic, and business communities. It should be viewed as a new product which, while still in development and thus facing the attendant risks of market acceptance, appears to be on track to becoming a useful tool for communicating and teaching basic concepts underlying economic development and policy making.

The panel's experience in observing and playing SENSE games at IDA has proved to them how engaging the game can be; players quickly become immersed. Because player decisions and interactions shape the dynamics of the SENSE economy, the game is neither a rigidly scripted exercise nor a predictive analytical tool. The game is a platform for learning-by-doing. It can be compared to a flight simulator, in that it allows policy makers, banks, and firms to "test-fly" alternative strategies in a developing economy. They can make a lot of mistakes – and learn from them – without actually incurring the attendant damage. Experience suggests that senior officials can learn more from a well-structured learning-by-doing game than from traditional classroom lectures on economic principles.

Used appropriately, SENSE also can promote teambuilding within player cells, and foster interactions and understanding across players representing firms, financial institutions, international institutions, and government. The panel particularly emphasized the potential for SENSE to focus players' attention on long-term economic development issues, missing in most post-conflict reconstruction scenarios. These aspects of the game

most intrigue the players and panelists involved with international financial and assistance communities. SENSE is the first effort by anyone to focus on the longer-term issues of concern to the international community. These communities are striving in many regions of the world to create ways to promote cohesion and sound economic development policies.

Those concerned with post-conflict reconstruction within these communities support the US military's interest in using a gaming framework such as SENSE in Bosnia, where traditional approaches are making little headway in bridging the ethnic, cultural, and religious differences that retard economic development and imperil stability. More of the international organizations involved in Bosnia are coming to recognize that such "process"-oriented approaches for promoting reconciliation and recovery might constitute an important new element in their overall strategy. The promise of SENSE is that it could organize multi-ethnic groups into teams, and provide a learning-by-doing environment for these players to learn the economic benefits of cooperation across a range of activities. Game playing will help reveal the constraints to progress associated with the divisive political policies maintained by the top Bosnian leadership. Crucial to such a process approach is the inherent flexibility of SENSE to frame and address relevant challenges, along with the continuing engagement of the users in the design and implementation of the game.

Given these strengths, the SENSE game has many potential applications. Although the development team has targeted its efforts toward the expected initial application of SENSE in Bosnia in 1998, a number of other developing countries could profit from the use of SENSE, including countries in central Europe, Asia, and Africa. In addition, although developing nations are the primary target of the SENSE game, SENSE also could be used for training and coordinating many of the Western international organizations that deal with these countries. These organizations often act independently, with little coordination among themselves. Used collaboratively, SENSE could help build understanding among these important contributors to economic development.

While the panel sees great potential in SENSE, it also finds that considerable work remains to be done before the game will be ready for its initial application. The

panel offers a wide range of options for expanding the scope and applications of SENSE; many of these are long-term development activities. At the same time, the panel has identified several high-priority tasks that should be completed as the SENSE development team prepares for the initial application of the game in Bosnia.

In pursuing the important steps ahead, the panel cautions that the SENSE development team must remain careful to ensure that a Mustang and not an Edsel is produced; that is, SENSE must meet its broader goal of creating an effective teaching tool, as well as succeeding from a technical standpoint. To fulfill its potential, SENSE must be embedded within an effective seminar structure; it must become more than an engaging video game. As one reviewer put it, SENSE can be likened to a surgeon's scalpel: it is a tool with many uses – some productive, others harmful. Careful thought must be given to the design and execution of game play. In design, it is essential to clarify game objectives and mesh these with an appropriate seminar environment, with appropriate participants, and a well-structured game scenario. In execution, it is essential to convey confidence through the competence and experience of the game managers and guides. Many of the panel's comments in Chapter IV identify steps the development team can take to ensure the seminar structure is fully effective. In particular, the reviewers emphasized the need to engage users in the design of each application, and to ensure that game-playing is tailored to meet the needs of the host nation. The panel believes that if the proper steps are taken, the development team could successfully deploy SENSE with about three months of additional preparations.

The remainder of this document describes possible improvements and enhancements to the SENSE game and the surrounding seminar structure. Some technical issues regarding the structure of the model follow in Chapter III. A number of improvements are suggested that will improve the playability and fidelity of the game. Chapter IV discusses the kinds of preparations the panel believes should be undertaken prior to fielding the SENSE game. Chapter V distills this discussion in the form of the panelists' high-priority agenda for preparing the SENSE game for initial employment in Bosnia.

### **III. TECHNICAL ASSESSMENT**

The panel's comments on the technical aspects of the SENSE game are organized here into five categories: economic behavior of the game, business play, government play, social and ethnic issues, and the psychological dimension of the game.

#### **A. ECONOMIC BEHAVIOR OF THE GAME**

A first-order criterion for the economic evaluation is that SENSE should not teach "wrong" lessons. The framework must be sufficiently realistic to allow the participants to observe economic variables moving in reasonable ways. To learn from their experience, players must be confident that the underlying structure of the model is correct. Reviewers concluded that the dynamic behavior of the main variables in the game is basically plausible. Game participants make the investment, finance, and pricing decisions. The responses in terms of supply, demand, and market-clearing mechanisms are plausible. The details are appropriately left in the background (since these technical aspects of the model are not of interest to most players) and are subject to being gamed by more sophisticated players. In general, the reviewers agreed that, while it is important that SENSE is founded on sound economic principles, the sophistication of the relationships is probably of secondary importance.

A few specific irregularities were observed, which were easily explained by the economists on the development team. For example, an idiosyncratic method for computing Gross Domestic Product (GDP) led to some spikes in this variable during one play of the game; this problem was identified and resolved. In general, potential volatility in the game is one of its least plausible aspects. The small number of players makes it possible for a single player to make such large moves as to move the entire economy. This is a limitation of the game that players should be made aware of. Such points as raised in this paragraph underscore the importance of having economists involved in the seminar presentations and SENSE gaming sessions. They will surely be called upon to explain the simulation structure and gaming outcomes, and their knowledgeable responses will increase participants' confidence in the overall structure of the model.

The review panel recommends modifications or additional work on several of the relationships that are modeled within SENSE, in order to capture needed feedback loops or to bring the model's equations more closely in line with established economic models. The required changes can readily be accommodated within the existing framework. The following paragraphs summarize the panel's proposals.

Macroeconomic dynamics: SENSE needs an improved characterization of economic behavior in periods of economic imbalance. This can be accomplished by incorporating some additional feedback mechanisms. For example, the game should reflect the negative consequences that result when the government runs a massive budget deficit. Similarly, the effects of incurring a large current account trade deficit (or surplus) should be reflected. These are precisely the kind of macroeconomic stabilization challenges that typically confront governments during economic transitions, and it is important that the government playing the game face these issues.<sup>1</sup> It is therefore important that players face the deleterious consequences of any poor macroeconomic and budgetary decisions. One approach for incorporating these variables could be through their effect on domestic interest rates, forcing governments to pay high interest rates for loans borrowed to finance its deficit. (Such interest rates generally cause banks to lend to the government and not to the private sector, thus delaying development.)

Household consumption: Another dynamic behavior requiring attention stems from the formulation of the household consumption function. This consumption function allocates household spending across the market segments in the economy. The particular form chosen (the Cobb-Douglas function) dictates that each household will always spend a fixed share of its income on a given industry (at fixed prices). In practice, the share of spending for basic goods (food) will decline as income rises, and the share spent on luxury goods (autos) will rise as income rises. (Actually, the model does incorporate a time trend adjustment, which permits the shares of consumption to shift over the course of a game, but this factor was not apparent at the time of the review.) It was suggested

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<sup>1</sup> Although the model's relative neglect of the forces of inflation is not too bad for Bosnia, with its Currency Board, this neglect could be a real problem if the model is used in other countries with more traditional central banking where there is greater risk of inflation.

that the development team adopt the “Perhaps Adequate Demand System (PADS)” as an alternative that would provide a more realistic model of consumer behavior.

Savings rates and foreign investment opportunities: Savings rates are fixed in the model. These need to be treated as an endogenous variable or at least an explicit scenario parameter. In particular, the game should include overseas savings alternatives, as the problem of capital flight is very real in most transition economies. This issue also came up in examining the game-playing behavior of the commercial bank and multinational corporations. The bankers appeared to be unrealistically liberal in making loans, a reflection of the fact that they did not have investment opportunities, except for loans, for game participants. Similarly, the multinational corporations (and perhaps domestic firms) should have opportunities to invest abroad. These kinds of changes will provide a much more realistic view of the challenges a transition economy faces in avoiding capital flight.

Wage-price inflation: The model needs a better representation of the wage inflation that is likely to occur as employment expands. The normal experience is that prices rise during a transition. One reason is the government’s monetization of its deficit, which has caused inflation in most transition economies. While such monetary factors are not considered in this model, more attention should be paid to the effect of rising employment on wage costs and hence production costs. Indeed contrary to the typical pattern described above, in the SENSE game prices tend to fall as the domestic industry expands and domestic production replaces more expensive imports.

There may be two ways to fix this. One is to incorporate an informal economy, such that workers have alternatives to employment in the formal economy. This could give rise to an upward supply curve for labor to the formal economy. Currently the supply curve is essentially flat over a wide range of employment.

In a similar vein, it has been suggested that the Phillips Curve could be modified to create a stronger interaction between employment and inflation – at least at relatively high rates of employment. (The Phillips Curve provides a modeling relationship between the rate of unemployment and the rate of inflation. In its original formulation the curve captured a relationship observed in most economies: that as unemployment falls, inflation tends to rise. A major debate centered on this relationship in the 1970s and 1980s,

because this curve would not predict events such as the “stagflation” that occurred in the second half of the 1970s, when historically high unemployment and high inflation persisted side by side. Most economists now agree there is a relationship between unemployment and inflation in the short run, but in a different form: it is between the level of unemployment and the rate of change in the level of inflation.)

Investment mechanisms: The treatment of investment could be improved in several relatively minor ways. First, the term “greenfield investment times” seems arcane, and perhaps more familiar terms such as “investment lag” or “time to build” would work better. Second, the model assumes debt servicing begins immediately on the entire amount of a construction project. It is more realistic to assume the loan will be drawn upon over the construction period, and that debt service may be postponed until the asset begins yielding revenues. Third, the model does not provide data on new investments, so players are generally unaware of what new investments other firms have undertaken. This raises the potential for boom and bust cycles in industries. This may be realistic in some industries, but it is also true that businessmen generally have information about the investments being made by other players in a sector. It would be more realistic to provide such information for players, perhaps through a financial newsletter. Finally, fourth, since capital is infinitely lived in this model (i.e. there is no depreciation of capital), all present value calculations should use an infinite asset life.

## B. BUSINESS PLAY

The SENSE game focuses on providing firms and banks a fast-paced, reasonably authentic environment for making decisions regarding investments, finance, and pricing. Generally, panelists concur that the game does a good job with this. There is, however, some question of whether the pricing mechanism contributes to the goals of the game, along with a couple other concerns. These are summarized in the following paragraphs.

Price setting: The necessity for firms to set prices for each sector in each period of the game may detract from the larger purpose of the game. At least one panelist found price setting to be a distraction. Every period, the firm must try and set price so that it remains above its marginal variable cost but below the market price. This consumes the better part of one player’s time, and it is unclear that this is the best use of this time. An

alternative is to automate price setting, so that the market-clearing price is calculated by the computer and all firms sell what they offer. This would allow firms to concentrate more on the strategic decisions facing them, such as investment and financing strategies.

Multinational Firms, International Organizations, and Non-government Organizations: Players experienced with international business began their play by trying to establish joint ventures involving international and domestic firms. While they were able to negotiate deals, they found that the game had not made provisions to handle them. They strongly recommended that model be modified to accommodate joint ventures, and to reflect the potential effects of joint ventures on costs. Generally, joint ventures are employed to accommodate technology transfer or the introduction of new products, or to overcome bureaucratic hurdles to operating in the domestic economy.

Issues were also raised with the play of international aid organizations. They should be divided between economic development agencies that lend to public and private enterprise, and grant-making assistance and refugee support agencies. Similarly, non-government organizations typically focus on social indicators, and their role is often to raise funds and to attack social problems directly. Thus, the effects of direct spending by such organizations on health or education should be incorporated in the game's social and economic indicators.

Firm goals: How should firms measure success? Firms tended to focus on cash on hand, but this is not the correct measure. Firms should focus on net worth, and the displays have been altered to emphasize this. In addition, some players thought firms might wish to contribute to social development, private education, or health care for example, and that mechanisms should be available for doing this.

Sector definitions: Some players believe that more intuitive definitions of the business sectors would be useful. One often-cited example is the Defense and Public Services sector. In addition, some players thought more concrete definitions for the economic sectors would be a good idea. Instead of the "Food" sector, they might have preferred a specific product, such as bread, or even a specific brand, such as Pepsi. Associated with these products would be prices that are more closely aligned with the real prices for these goods. The panel made no recommendations on naming the sectors,

but the development team may want to explore how the use of specific names would affect game play in some trial runs.

### C. GOVERNMENT PLAY

The play of the government was the subject of extensive discussion among game participants as well as among the review panelists. There is concern that the government play does not have the appropriate “feel,” and that the appropriate range of choices is not represented. This is an area where some of the basic design decisions may need to be reconsidered.

Government roles: Reviewers questioned the feel of government play. Whereas business play seemed reasonably authentic, government play seemed contrary to experience. SENSE government players felt they needed to act very fast to keep pace with the game, and had more information and decisions to make than they could reasonably address. In reality, governments in developing nations tend to act slowly, and do so with very limited information. A government decision is also implemented far less quickly and effectively than the game presumes. A number of ideas for addressing this concern were discussed, including expanding the number of government players and slowing down the play of the game. It was also recommended that consideration be given to introducing a random element in government decision making, to capture the uncertain effects of their actions as well as how the “fog of war” can shape decisions.

From the standpoint of not teaching “wrong” lessons, one reviewer questioned the nature of the tasks and decisions that have been assigned the government. The government should not view itself as the nucleus of economic development. In particular, the government should not be encouraged to be a direct lender to the private sector; in practice this leads to corruption and inefficiencies. Secondly, government should be discouraged from trying to set priorities across sectors. Picking winners has proven to be a recipe for failure in transition economies.

Finally, care should be taken to incorporate important government economic policies in the game, especially when they create significant constraints on development. For example, it was noted that the Bosnian government has not yet passed privatization legislation. Also, the roll-out version of the game included a central bank, whereas such a

bank has not yet been established in Bosnia. Inclusion of such policy issues will bring needed focus to the deliberations and actions of government participants.

Visibility: It was typically unclear to firms what the government was doing, or the relevance to their own decisions. Press conferences have been used experimentally as a means for allowing the government to announce its intentions. But specific decisions regarding tax policy, etc., were not announced. Subsequent play should use news bulletins or newsletters to convey information about government actions and intentions.

The guns-butter tradeoff: Military and security realities need to be played more explicitly. As it is, the game imposes no apparent reason not to cut military spending to zero. Some counterbalancing considerations need to be incorporated, either in the model, in creating a body that plays national security concerns more explicitly, or in building the context through the pre-game seminars.

Corruption and crime: The panel believes that consideration should be given to making corruption and crime a more prominent feature of the model, but it also cautions that this is very difficult to model realistically, especially in the context of a game where there are relatively few players. These are important real-world factors in the economies for which the game is designed. They could be incorporated in a number of ways. One would be to allow government officials to take personal payments; this would influence their decisions over such variables as government loans. In addition, variables such as permits could be introduced to widen the set of wealth-transferring opportunities available to government officials.

Nationalized industries: Government roles in nationalized industries need to be more explicitly modeled in order to permit privatization of nationalized industries. If the government holds assets in nationalized industries, this could take the form of sales of government assets. Alternatively, the government could retain exclusive rights to sell in a market, which could be modeled through the sale of government-controlled permits.

Government performance measures: Feedback for government players would also be useful. For example, players might be provided a government approval index, which could be accomplished by applying one or more weighting factors to the social and economic indicators that are already reported in the game.

#### **D. SOCIAL AND ETHNIC ISSUES**

Many of the SENSE roll-out participants and some reviewers recommended that the SENSE game more explicitly play ethnic and regional issues, particularly when it is to be used in Bosnia where these issues dominate politics and economics. There is considerable debate on how to address this concern. A central question is whether the structure of the model should be altered to accomplish this, or whether it is possible to incorporate these issues through the seminar structure and through the management of the composition of player cells. Right now, the SENSE model does not explicitly address such factors. The SENSE development team had intended to incorporate such factors through the seminars and by forming multi-ethnic teams that would be encouraged to collaborate.

Some roll-out participants and reviewers believe that the game must incorporate a regional structure if it is to be useful in Bosnia. They question the assumption that there is in fact a single government of Bosnia, such as modeled in SENSE. They argue that there are elements of three separate governments at work in Bosnia. Moreover, national, municipal, and local actors frequently are vying for control. To these participants, capturing such political realities is critical to successfully applying the model.

Countering the desire to incorporate these political realities within the formal structure of the game is the question of whether an analytical framework such as SENSE could accurately reflect the issues at hand. There is some concern that such a model is more likely to misrepresent the underlying issues than it is to accurately capture them. Hence there is a risk of violating the principle of "do no harm," by teaching erroneous lessons. In addition, tailoring the SENSE structure to the Bosnian case defeats the developers' goal of creating a general framework for teaching basic economic lessons.

The panel is mixed in its views on how to proceed. Its principal recommendation is that careful thought be given to identifying the ethnic issues that can be addressed in the model as it stands, and to examining the costs and benefits of attempting a more robust modeling of regional structure or political divisions. The SENSE development team must carefully consider the question of whether the purpose of the game can be achieved in a Bosnian application without explicitly modeling these political divisions.

One reviewer felt strongly that the development team should discuss the structure involving ethnic diversity with the potential Bosnian customers, and engage them in making decisions regarding the final design for this application. At a minimum, the development team should consider how the seminars can address ethnic issues, as well as to examine how games could be structured and player cells constructed to best capture these issues. For instance, the government could be comprised of a coalition of Muslim, Serbian, and Croatian players.

Names and terminology: Reviewers agree that it is probably wise to use the generic country name of AKRONA and other terms that have no possible ethnic connotations. They also suggest that the game designers define some collaborative challenges for the teams, which could contribute to team building within multi-ethnic teams. For example, the teams could be asked to name their company at the outset, to choose the roles for cell members, or to decide as a group on their initial portfolio of investments.

Social indicators: There was general concurrence on the social indicators used in the game. There was concern that players such as the international organizations and non-government organizations should be able to take actions that influence social indicators. Those playing the international organizations want, for example, to be able to make grants for inoculations, which would have a direct effect on infant mortality. Education is another area where privatization would allow direct investments to be made by international organizations, foreign governments, or businesses. Another comment is that a lag structure should be built into the social indicators to reflect the fact that it generally takes time before spending improves conditions.

Media: It has been observed that many large war games use news flashes or newspapers as a means of communicating a wide range of information about the game. The discussion of government play noted that the media would be useful for conveying government policies and decisions. The SENSE development team should explore other uses and effects of the media in future tests of the game.

## **E. PSYCHOLOGICAL DIMENSIONS OF GAME PLAY**

As noted in the assessment section, everyone observing the play of SENSE is impressed with how engaging the game is to its participants, and the vigor with which they play the game. The game naturally induces team building within player cells, and it encourages interactions among the cells. The pace of activity and the degree of involvement required to successfully play the game contribute to the intensity of player engagement in the game. The panel observed several additional aspects of the game's design that promote these outcomes.

The physical set-up of the game for the roll-out at IDA is good. Players need to become comfortable with their own space before venturing out, and the individual player cells allow players to establish their home turf and become comfortable with their individual work environments. The proximity of players encourages interaction across teams. It was suggested that the arrangement be altered in the future so that game stations are placed around the perimeter of an open space, which could serve as a meeting area and "trading floor."

It is valuable to introduce players to each other, in order to break the ice and encourage interaction. Pre-game strategy sessions have facilitated this. The seminar environment will also contribute in future applications. The SENSE development team should carefully consider such physical factors as lighting and other "friendly" environmental factors that also help promote interaction. One specific suggestion is to make printers available to players so they can make paper copies of materials to share within cells and to use in communicating across cells.

Players may gain a feeling of ownership if they are permitted to customize the game to some degree. As noted earlier, they may be called upon to name their teams. It also may be desirable to allow participants to stipulate certain key parameters. This may give them increased confidence in SENSE.

And it has been suggested that certain rewards or "prizes" tied to game outcomes might create useful incentives.

While SENSE has worked well in its test applications to date, there are a number of concerns that must be addressed in using the game with other audiences. The panel

believes the following key factors should be a primary focus of the SENSE development team in preparing the game for application in Bosnia.

Computer literacy: A key determinant of the success of SENSE is the ability of the players to cope with the game's data-intensive computer environment. Some players may be overwhelmed by the combination of the volume of information, speed of play, the form of displays, and an unfamiliar computer environment. This may have important psychological implications. Individuals who have been traumatized as a consequence of war are often quite risk averse, resulting in passivity or even decision-making paralysis. It is essential that guides and facilitators remain sensitive to this reality, adjusting the pace and content of challenge accordingly. There is a potential that participants will be "shamed" by their inability to play the game, and may react negatively to the game as a result. Thus, screening, pre-selection, and training of participants is critical for success. Guides also play a major role in assisting participants to adjust to the game environment.

User interfaces: Effort should be made to ensure that the game is accessible to the players. It is like a "run and gun" football offense – very difficult to keep pace with the activity unless you are well prepared. In addition to tutorials and warm-up exercises, the simplification of displays and the use of intuitive graphical formats could help.

Language: Related to the issue of graphical displays is the choice of language to display. In Bosnia, there are two alphabets. Choosing either one seems a very bad idea. Keeping the screens in English is one option. Another is to allow a choice. The panel believes that offering choice is the preferred alternative if the computer technology permits it.

Player selection and assignments: Generation and gender issues must be weighed in constituting the teams for play. For example, there is a risk that computer-literate "20-somethings" could dominate their groups. This could help or hinder the play of the game, and could skew outcomes in unpredictable ways. A brash, inconsiderate youth could poison the attempts to build good will. Gender raises other issues regarding the appropriate composition of cells, which depend to some degree on the culture in which the game is being played. Aside from the relative substantive knowledge of men and women, the chemistry of male-female interactions can influence game outcomes. Women

may be ineffective in some environments where their leadership roles are suppressed; in others they may contribute important, team-building leadership.

Player tutorials: Given the complexity of the simulation, players are confused when they first sit down to play the game. They are immediately faced with a ticking game clock, numerous possible decisions, and equally numerous policies, all of which are initially unclear. Therefore a familiarization course should be incorporated as a precursor to the game playing. Perhaps players could rotate through all of the positions in a session that would total about four hours. This would provide them with a much better context for play, before the pressure of the game situation begins.

Guides: The guides who work with each cell will have a very difficult job, and their selection and training need to be done with great care. Guides must have a clear understanding of the SENSE framework and how to play the game. And it is very important that some of the guides understand the basic economic foundations of the game so that they can answer questions as they arise.

Beyond this, in deploying SENSE abroad, guides will need language skills, or be teamed with translators, and they also must have some education in and exposure to the local culture. They will need to be sensitive to the potentially wide range of participant perspectives they may confront. In particular, guides must be sensitive to the possibility of inducing “shame,” particularly among senior players. Short of paralysis, game players may be extremely conservative, as their cultural experiences under socialism may have conditioned them to behave this way. The IDA guides did a good job in addressing these concerns with American players during the SENSE roll-out, but the challenges will be greater with players that have less exposure to computers, that think in a different language, and that are not culturally attuned to Western economic and business principles.

## IV. REQUIRED PREPARATIONS FOR FIELDING SENSE

Given the importance of the psychological factors outlined above, the panel sees several preparatory actions that are at least as important at this point as the technical improvements and enhancements discussed in the prior section. These are areas the development team indicates it plans to address, but they nevertheless deserve emphasis here.

Clarifying game goals: Games played using SENSE can be structured to serve a number of purposes. Some might be structured to assist players to better understand or diagnose problems that arise in developing economies; others, to focus on strategies for treating specific problems. These two kinds of games are complementary but have different goals. In designing games, the SENSE developers should be careful that they do not prejudge a diagnosis. SENSE games should instead be structured to assist participants in making their own determinations regarding diagnosis and possible treatments, because only they (the participants) have the in-depth understanding of their economy and their institutions. This is essential to the proposed “process” approach for addressing the post-conflict reconstruction issues in Bosnia.

Games should reveal underlying problems, and this can involve a degree of pain and uncertainty for the players. Just as flight simulators can lead to crashes, SENSE gaming sessions can lead to bankruptcy and failures of economic policy. There are risks associated with playing the game in this mode. Delving into ethnic issues is a case in point. Nevertheless, there is a need for players to gain an understanding of the important features of these ethnic issues, and to recognize that problems can have solutions. There is also a danger in structuring games that hardwire in assumed treatments without first obtaining an accurate diagnosis, because the gaming team is unlikely to fully understand the underlying problems.

Similar arguments apply to the economic dimensions of the game. Dysfunctional economic strategies and policies can be diagnosed in the game, but these lessons can also be painful to learn. On the other hand, spoon-feeding the textbook solutions may fail to

get the lesson across, or may fail to address the real underlying issues that need to be addressed. The game designers demonstrate an awareness of these issues, and have given considerable thought to them already, but the panel stresses the importance of continuing to define goals and to be purposeful in constructing each game so that the players can derive the maximum benefit from playing SENSE.

Seminar materials: At the time of this review, many of the seminar materials that will provide context for, explain, and focus the SENSE games remain to be developed. As noted earlier, these materials are crucial to the successful application of the model, and therefore the peer group would like to review them as they become available. The panel is concerned that the limited written materials that were available to them describing the seminars and the overall goals of the SENSE project remain excessively broad and general. In developing the seminar materials, there is a need to be clearer and more specific about what the model teaches, and to limit expectations. As an example, it is not clear how the specific play of the game teaches broad lessons relating to the benefits of a sound legal framework and a market economy.

In developing the seminar materials, it will be important to consider how the structure of the model or the playing of the game should be tailored to teach certain lessons. For example, international players could be tasked to play their roles to reflect “realistic” behavior, so that the students playing firms, banks, or the domestic government could observe how international organizations react to their decisions. Alternatively, a game could be designed using “realistic” firms, banks, and international organizations in order to teach certain lessons to the cell playing the domestic government. These examples obviously do not cover all possibilities, nor are they necessarily the highest priorities; they simply illustrate the kinds of alternative structures that may be adopted to address certain topics. They also suggest the kind of preparation that may be necessary in structuring games to get key lessons across to the students.

Field testing: There is some debate within the panel as to how quickly the development team should engage Bosnians in preparation for fielding SENSE. Several panelists believe it is essential to do as much testing of the model as possible within the US before applying it in Bosnia. They argue that the development team needs absolute

confidence that it knows how the game will go. The developers also need a clear understanding of how Europeans will react to the game, and have opportunities to adapt prior to the first application. Finally, there will inevitably be translation problems that will only be revealed with experience in playing the game.

Every application of the model will help to reveal unintended consequences -- both good and bad -- and will offer ways to improve the capability of SENSE to meet its objectives. Applications will also reduce the scope of surprises. Questions will inevitably arise during game play, and the credibility of the game will hinge on the ability of the experts to answer them. As the development team gains experience with game play, they will become better able to describe general behavior and quirks at the outset so players come to understand the general behavior of the model, and learn to trust that it performs consistently.

The counter view is that early engagements with Bosnians, even before the model and seminars are perfected, can only help to build trust and a sense of partnership and ownership within Bosnia. In this view, the Bosnians are predisposed to embrace a computer-based simulation game such as SENSE, and will readily support the development team in tailoring the game for play and in preparing for its application. Bosnian participants should not be viewed as pawns that are to be manipulated in playing the game, but as full partners.

The development team will need to weigh these alternative views in its preparations for fielding SENSE in the coming months.

Building an in-country infrastructure: Game participants and reviewers with experience in Bosnia emphatically stress the need to begin immediately to lay a groundwork within Bosnia well in advance of playing the SENSE game there. In-country sponsors or proponents can immeasurably improve the prospects for successful play. They can help underscore credibility, identify appropriate participants, and provide infrastructure such as computer support, translation services, and guides.

The US military and the Marshall Center are the intended proponents and supporters. However, there is great interest in supporting the game outside the military. International organizations assisting in Bosnia would like to contribute. There likely are

Bosnian groups that are eager to employ a framework such as this in their country. One panel member noted interest within the academic community in Bosnia. He has already presented faculty members of the University of Sarajevo with the idea of using computer-assisted assessment methodologies, and has received strong support. Another potential in-country sponsor is the "Institute for Democracy," a joint Austrian-Bosnian institution headed by Dr. Ejup Ganic, a Bosnian Vice President, and formed to assist in building democratic institutions.

While encouraging IDA to seek in-country support, the panelists also offer the caution that the IDA developers should avoid becoming hostage to potential supporters. The SENSE developers should thus seek support and participation, but avoid situations that allow other officials or organizations to veto or slow down the development effort, or to use the game to serve an unintended agenda. One panelist observed that strong US military support for deploying SENSE will continue so long as US troops are committed, and further noted that the support of the CINC is extremely helpful in bypassing the need to slowly build consensus among all the potential participants and stakeholders. Given the range of participants, and the scope of divisive issues, this panelist believes such support is essential for a successful deployment of the game.

Finally, looking beyond the near-term efforts, the panel also encourages the SENSE development team to look toward building a community of interest that could support subsequent applications of the game.

## V. RECOMMENDED NEXT STEPS

Panelists were asked to identify the highest priority tasks that should be undertaken by the IDA development team. Specifically, they were asked to identify the tasks that should be completed in the next three months, assuming the model is to begin its initial application in Bosnia later in 1998. Panelists concur that the SENSE framework can be made ready for deployment given a three-month preparation period. This will require limited software modifications, a focused effort to establish an effective seminar structure and player tutorials, and extensive field testing to fine-tune the relationship between the seminars and the game, and to wring out translation problems. Following are the panel's priorities:

*Peter Murrell*

1. Don't attempt to revise the model to incorporate regional issues. It is too hard to model regions; an economic simulation is unlikely to get all the political relationships right, and unlikely to capture the underlying issues of ethnic divisions.
2. Solve the language problem – it will be a major challenge to convert the game to another language.
3. Improve modeling of the macroeconomic consequences of current account and government budget deficits so that policy-makers must react to imbalances or see their economy deteriorate.
4. Incorporate the guns-versus-butter tradeoff in government decision making.
5. Provide government players with feedback – e.g., an approval index.
6. Incorporate random error into the government process so as to represent the difficulties that officials have in implementing their policies.
7. Play the game as often as possible in the coming months, and make any adjustments necessary to ensure that the dynamics look reasonable under a wide variety of circumstances.

***Dayton Maxwell***

1. The development team needs to establish a three-part strategy for fielding SENSE. First, they should seek to engage potential supporters in Bosnia as soon as possible. Bosnian sense of ownership is essential for success, and they should be made partners in the game rather than pawns to be manipulated by the game. Second, the development team should engage the international community, including AID, the World Bank, and the IMF. Third, the development team should work collaboratively with the Marshall Center.
2. Start now to build partnerships among international organizations and the Bosnians; use subsequent games to implement this strategy. First, conduct another exercise at IDA with World Bank and AID people. Second, undertake an exploratory mission to Bosnia as soon as possible and begin playing the game in Bosnia as quickly as possible. Don't wait to fine-tune the model. Engage Bosnians in designing the games to be played there, and use model play to build a partnership with interested parties in Bosnia.
3. Focus on how to address Bosnian ethnic issues head-on in the game without this aspect of the game becoming counterproductive (good judgment is very much needed here). USAID has two Bosnian employees who could be very helpful on this. There is a risk that underplaying these issues will render the game irrelevant to Bosnian players. Examine the feasibility of adding a regional dimension to the model's structure; at a minimum, think through how best to do this with the tools at hand.

***Clopper Almon***

1. The development team must carefully craft the seminars, providing the context for SENSE game playing. The success of the game hinges on these seminars, as they will determine whether SENSE becomes an exciting video game, or an effective tool for learning-by-doing. These materials are so important to success that they should be provided to the panel for their review at the earliest opportunity.

2. Concentrate in the near term on the model's translation, and how to get the model across to the target audience. Translators often don't know economics, and their literal translations will inevitably garble the meaning of economic terms.
3. Don't tailor the model too much to the Bosnian region. There are basic economic lessons to be learned from the model as it stands. (Almon agrees with Peter Murrell that incorporating a regional structure is too hard to do correctly.)
4. Incorporate automated price setting to replace price setting by the firms; this will focus firm players on the more strategic issues, such as investment and finance.

***Gregory Saathoff***

1. Work on improving graphical interfaces. This will expand the game's accessibility by helping overcome players' limitations in computer literacy as well as language barriers.
2. Focus on developing an effective tutorial for players.
3. Add printers to the work areas – these will aid in decision making and communications.
4. Physically arrange the space to promote cooperation – establish a central trading area, for example.
5. Incorporate military security realities, which are the underlying rationale for the guns versus butter tradeoff decisions that must be made by the government.
6. Perform test runs with ethnic groups in the US to the fullest extent possible. This will uncover cultural sensitivities, reveal opportunities, and help scrub out translation problems.
7. Be prepared to allow participants to tailor the game to their wishes – people want to customize (e.g., paint their new house) it makes it their own.

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